

# Perceptions and Attitudes of Student Teachers and Their Cognitive-Metacognitive Awareness in Mathematics in Colleges of Education in Zambia

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## ABSTRACT

The purpose of the study was to establish perceptions and attitudes of student teachers and their cognitive-metacognitive awareness in mathematics in colleges of education in Zambia. Although there has been abundant research into perceptions, attitudes and cognitive-metacognitive awareness in teacher education, relatively little research has focused on student teachers' perceptions and attitudes and their cognitive-metacognitive awareness in Zambia. Perception is a cognitive process through which individuals view, interpret, and understand their surroundings and environment and includes impressions formed about objects, events, and people. Attitude towards mathematics denotes interest or feeling towards studying mathematics. Metacognition is intertwined with cognition and affect. Metacognition is "thinking about thinking" or cognition about cognition. The key findings indicated that student teachers had moderately high metacognitive awareness levels in both colleges. According to the results of the analysis, there was not a significant difference among the scores of metacognitive awareness of student teachers ( $F = 0.522; \rho = 0.491 > 0.05$ ) according to means. We accept the null hypothesis that the means in the two colleges of education do not vary since  $\rho > 0.05$ . Results indicated that student teachers in both colleges of education had higher levels of their perceptions and attitudes towards mathematics. Further, results from the Focus Group Discussion (FGDs) indicated that student teachers perception of their performance is attributed to lecturers' methods of teaching and lecturers' attitudes towards them. Results from the focus group with all the years of study indicated that lecturers teach them procedures of solving problem without student teachers' participation. The results showed that lecturers teach the 'how' approach of solving mathematical problems without the 'when' and 'why' processes of solving problems. Therefore, this study recommends that teacher training programmes should include activities through the development and support of metacognitive awareness and affective factors that will be helpful in terms of professional and personal development for mathematics teacher trainees.

**Key words:** Attitudes, Perceptions, Cognition, Metacognition and Volition, self-efficacy.

## 1.0 INTRODUCTION

This study focused on the mathematical education of secondary mathematics student teachers. The study aimed at establishing student teachers' perceptions and attitudes towards mathematics and their cognitive-metacognitive awareness in mathematics in Colleges of Education in Zambia. An important argument in educational practice today centers on the debate of either, whether learning can proceed naturally, without much intervention or whether there is, need to develop learning and teaching strategies that would improve learner achievement. Much of the existing research relating to students preparation to teach, particularly in secondary schools often shows that they have a weak mathematical background and lack of understanding of the subject (Jirotkova and Stehlikova, 2004). In Zambia, at all levels, that is, from Grade 1 to University, learners have been performing poorly in Mathematics, a trend that has kept on deteriorating (National Assessment Project in Zambia, NAPZ, 2009). According to the University of Zambia (School of Education Handbook: 2007), the school regards one particular way as special and dear to its operations; providing high quality teachers and other personnel in the education sector. Researchers like Edwards (2008) and Babich, (2010) have indicated that learners who are metacognitive aware of their learning abilities improve in their performance. In Zambia, whether student teachers are metacognitive aware of their teaching and learning processes is yet to be established. The Ministry of Education (MoE) (2007, p.65), in the National Implementation Framework states that, "Currently, teacher education training does not meet the demand for teachers at various levels within the education delivery system....more acute are the shortage of qualified teachers of mathematics and science education." No studies conducted, so far, have looked at student teachers' perceptions, attitudes, cognitive-metacognitive awareness levels in Colleges of Education in Zambia, and metacognitive strategies. Most studies have looked at either metacognition or affect, independently from each other (Efklides, 2005). Hence, there was need to investigate and explore the perceptions and attitudes of student teachers with their cognitive-metacognitive skills and awareness in Mathematics.

### **1.1 Statement of the Problem**

Researchers (Liljedahl, 2012; Ball & Wilson, 1990; Carlson & Bloom, 2005; Garofalo & Lester, 1985; Kloosterman, 2002; McLeod, 1989; Schoenfeld, 1992; Shaughnessy, 1985; and Hannula, 2012; Shoenfeld, 2010), have linked affective behaviour and cognitive-metacognitive behaviour to success or failure in mathematics learning, understanding, and problem solving. These researchers have suggested that successful cognitive performance depends on having not only adequate mathematical knowledge but also an awareness and control over that knowledge. It is education, particularly Mathematics, English, Sciences and technological subjects that can be used to achieve a more rapid economic, social, technological and scientific development of the country (Edwards, 2008). Edward's assertions are in line with the Ministry of Education (MoE) in its policy document 'Educating our Future' (1996, p.110) in which it states that, "The outstanding achievement of teacher training colleges is that they have never failed to provide the country with a regular supply of qualified teachers. But, they have been handicapped in the accomplishment of their mission by inability to bring the quality of their output to the level they would have desired."

However, prospective secondary mathematics teachers often have limited opportunities (within a problem-solving environment) to connect their advanced college level mathematics with the mathematics they will teach (M.o.E, 2008) annual report. McLeod (1992) suggested that when researchers integrate affective factors into studies that address cognitive issues, they strengthen all mathematics education research. Oatley and Nundy (1996, p.258) explained that, "Neglecting the influence of the emotional (attitudes and beliefs) realm would distort an understanding of the cognitive process of education in general"

In Zambia, like in many other countries, learners in schools, colleges and Universities have performed poorly in Mathematics. It is desirable that prospective secondary mathematics teachers need to have opportunities to develop substantial deep mathematics understanding for teaching in a problem-solving context to implement the curriculum envisioned by the M.o.E, (2008) annual report. The falling level of academic achievement might be attributed to teachers' non-use of teaching strategies that enhance learning, like cognitive-metacognitive strategies and self-regulatory approaches.

Manchishi and Masaiti (2007), state that initial teacher education should strive to equip trainee-teachers with knowledge attitudes, behaviors and skills they will require to perform effectively in the classrooms, schools and communities. Therefore, the researcher saw that it was imperative to investigate and establish the perceptions and attitudes student teachers have towards mathematics and their cognitive-metacognitive skills and metacognitive awareness in teacher training colleges in Zambia. According to Hannula (2011) he indicated that positive perceptions enhance a leaner's attitudes and motivation towards a subject.

### **1.2 Objectives of the Study**

The specific objectives of this study were;

1. To explore student teachers' cognitive-metacognitive awareness levels in their learning processes.
2. To explore perceptions and attitudes college student teachers have towards Mathematics.
3. To establish student teachers' perceptions on their academic performance.
4. To determine whether student teachers' metacognitive awareness levels vary according to colleges.
5. To determine whether student teachers' perceptions and attitudes towards mathematics vary according to colleges.

### **1.3 Research Questions**

The study advanced the following research questions;

1. What are college student teachers' cognitive-metacognitive awareness levels?
2. What perceptions and attitudes do student teachers have towards Mathematics?
3. What are student teachers' perceptions on their academic performance and lecturers' methods of teaching?

### **Hypothesis**

1.  $H_0 : \bar{X}_1 = \bar{X}_2$ . i.e. All the means in student teachers' scoring in metacognitive awareness levels in the two colleges are significantly equal.  
 $H_1 : \bar{X}_1 \neq \bar{X}_2$ . i.e. All the means in the student teachers' scoring in metacognitive awareness levels in the two colleges are not significantly equal.
2.  $H_0 : \bar{X}_1 = \bar{X}_2$ . i.e. All the means in student teachers' scoring in perceptions and attitudes towards mathematics in the two colleges are significantly equal.  
 $H_1 : \bar{X}_1 \neq \bar{X}_2$ . i.e. All the means in student teachers' scoring in perceptions and attitudes towards mathematics in the two colleges are not significantly equal.

## LITERATURE REVIEW

Literature from various researchers regarding student teachers' perceptions and attitudes towards Mathematics, their cognitive and metacognitive skills and their metacognitive awareness has not performed in Zambia. The research focused on perceptions, attitude, cognition and metacognition in general as they relate to teaching and learning of Mathematics and to learners' performance in the subject. Rysz (2004, p.15) states that, "In order to be better teachers, educators examine how students learn, utilize pedagogy to address the students' needs, and to carry out methods of instruction that encourage construction of knowledge into a viable organization of facts and procedures." In the teaching and learning processes, there are three major areas which have been studied by many educators and curriculum specialists, and these are cognition, affect, and metacognition. Metacognition is intertwined with cognition and affect. Most conceptualizations' of metacognition have in common that they take the perspective of 'higher-order cognition about cognition' (Veenman, et al., 2006). In metacognition there is a higher-order agent overlooking and governing the cognitive system, while simultaneously being part of it. In fact, metacognition draws on cognition. Belet and Guven (2011, p.32), states that, "Metacognition is a domain which completes the constructivist learning theory that enables learners relate their old information with new information, and get aware of their own learning internalise what they learn." From Belet and Guven (2011) assertions, students who have metacognitive skills, are aware of how to accomplish the problems posed in the learning processes. History of the development of metacognition and its models and affective factors are discussed, leading to current thought on how students can be guided into developing cognitive-metacognitive awareness and adjustment of their epistemological beliefs (attitudes). Student teachers are expected to develop an overall comprehension of mathematics and a more itemized awareness of understanding pieces of information and strategies, pedagogy that supports and develops cognitive and metacognitive skills (Rysz, 2004). Metacognition is a concept that refers to variety of epistemological processes.

Metacognition essentially means cognition about cognition; that is, it refers to second order cognitions: thoughts about thoughts, knowledge about knowledge, or reflections about actions (Hugo; Bertram; Green, and Naidoo, 2008). So if cognition involves perceiving, understanding, remembering, and so forth, then metacognition involves thinking about one's own perceiving, understanding, remembering etc. these various cognitions about cognitions can be labeled 'meta-perception', 'meta-comprehension', and 'meta memory' with 'metacognition' remaining the super ordinate term. Perceptions and attitudes are variables in the affective domain that are very important to consider in the student performance in Mathematics. Edwards (2008, p.30), states that, "A common theme within literature suggests that attitudes toward Mathematics have three main components: cognitive, emotional, and behavioral components. The cognitive component of an attitude consists of thoughts, belief, and perceptions relative to mathematics and problem solving." Edwards' assertions are a clear picture of the intertwining of affect, cognition, and metacognition.

Perception is a particular way of thinking about something, in this case Mathematics. Garg (2011, p.110) defines perceptions as, "a way of seeing or understanding a thing, phenomenon or process etc. Perception denotes an insight of an overtly in the form of opinion." According to Bandura (1997), a person's perception of his or her capabilities at performing a given task called self-efficacy. Another factor in the affective domain that intertwines with perception is attitude of learners towards a particular subject, in this case mathematics. Attitude is one factor that is important in the performance of learners in academia. Ekpete (2012, p.168) states that, "Students' performance in mathematics depends on many factors and stands out to show how well a student is doing." Attitudes are composed of beliefs, opinions and thoughts linked up with behavior and it influences the level of consistency (Felder, Felder, & Dietz, 2002). Leon Festinger gave the benchmark concept of attitude in the cognitive - dissonance theory on attitude formation (Woolfolk, 2010). For example, Fister and McCarthy (2007, p.27) states that, "a student has to calculate  $\frac{2}{3} \times \frac{4}{5}$ . The student will quickly give the answer  $\frac{8}{15}$ . If asked to explain why  $\frac{2}{3} \times \frac{4}{5}$  is  $\frac{8}{15}$ , the student will state the rule  $\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$ ." In such a case, the student just follows or remembers the rule without knowing why. In such a question, a student should be able to relate this rule to a learnt visual representation or perceived representation that would provide a simple explanation, as in figure 10 below:

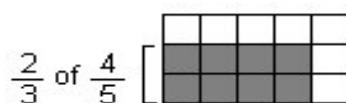


Figure 11: Visual representation of  $\frac{2}{3} \times \frac{4}{5}$

Visual presentation can help learners to understand the concepts of multiplication. In Zambia such methods of teaching are not common.

## METHODOLOGY AND PROCEDURES

### 2.0 Research Design

This descriptive or normative survey study was aimed at exploring student teachers' perceptions and attitudes towards mathematics and, their metacognitive knowledge and regulation of cognition, metacognition in general. The study was initiated for gaining better understanding about student teachers' perceptions and attitudes towards mathematics and their cognitive-metacognitive awareness levels. According to Paggarwal (2012, p.231), "descriptive or normative survey is that method of investigation which attempts to describe and interpret what exists at present in the form of conditions, practices, processes, trends, effects, attitudes, beliefs, etc... it is an organized attempt to analyse, interpret, and report the present status of social institutions, groups or area." It is concerned with the phenomena that are typical of the normal conditions. It explores into the conditions or relationships that exist, practices that prevail, beliefs, points of view or attitudes that are held, processes that are going on, influences that are being felt and trends that are developing (Paggarwal, 2012). This study was initiated for gaining better understanding about student teachers' perceptions and attitudes towards mathematics, and their cognitive-metacognitive awareness levels.

### 2.1 Target Population

The study targeted student teachers studying mathematics in Colleges of Education in Zambia. The target population comprised student teachers of mathematics who are at levels and ages at which they are likely to form stable perceptions and attitudes towards Mathematics and develop stable cognitive and metacognitive strategies and skills.

### 2.2 Sample and Sampling Procedures

The sample was drawn from two secondary teachers training Colleges of Education in Zambian and targeted students pursuing a teaching course in mathematics. From a population of about 600 student teachers of mathematics, a sample of 300 ( $n = 300$ ) learners in first, second and third year in the secondary colleges of education in Zambia was drawn. The college sample was selected for the following reasons. Firstly, it would be easily accessible. Secondly, the cost would be fairly low and thirdly, less time would be spent in conducting fieldwork. The districts chosen were Mufulira, and Livingstone, as it was assumed that they would suffice to be representative of the teacher colleges of Zambia. According to Langbridge (2004), the larger the sample size, the greater the precision of the sample in representing the population from which it was drawn. Participants were randomly selected from each stream or year of study through simple random sampling method. According to Sidhu (2012, p.260), "Simple Random Sampling means that every member of the sample selected from the total population in such a manner that all members of the population have essentially the same probability of being selected." This approach is also known as sampling from sequential list or sampling by lottery system.

**2.3 Research Instruments:** The instruments used in this study were two; the two instruments examined the learners' perceptions, attitudes, and their cognitive-metacognitive awareness. The first questionnaire was a 52-item scale 'Metacognitive Awareness Inventory (MAI)' adopted from Gregory Schraw and Sperling Dennison (1994). The MAI is purported to be a measure of student metacognitive knowledge and regulation that is widely used in the field of education. The MAI is an instrument many researchers have utilized in the assessment of learners' metacognitive awareness (Rysy, 2004; Shraw and Moshman, 1995; Livingston, 2003; Lai, 2011; Babich, 2010; and Edwards, 2008) and it has been proven effective in measuring learners' metacognitive awareness levels.

The second questionnaire had two components; the first part measured student teachers' perceptions and the second part measured student teachers' attitudes, which were extracted from a 152-item scale, entitled, "Questionnaire in the Teaching of Mathematics (QTM)" which was formulated by Paul Ernest (1996). The questionnaire was used to establish the student teachers' perceptions and attitudes towards mathematics. All the questionnaires had Likert-type scales. In the three questionnaires, the response choices ranged from 'Strongly Agree, Agree, Uncertain, Disagree, and Strongly Disagree'. The questionnaire for the students' perceptions and attitudes towards mathematics included statements about how they regard or perceive mathematics in their learning processes. The questionnaire also included attitude statements on the way student teachers felt when learning mathematics, how they react when asked to, answer questions or solve problems in class. Student teachers' perceptions and attitudes were measured using the Likert Attitude -scaling method, which had items that tried to measure the same perception and attitude or behavior of student teachers towards mathematics (Oppenheim, 1979).

### 2.4 Data Analysis

Descriptive statistics for the Metacognitive Awareness Inventory (MAI) and the perceptions and attitudes questionnaires were utilized to provide information on the distribution of scores, average scores (i.e. mean

scores), using the statistical software SPSS version 20.0. The One-way ANOVA was conducted and other statistical tests like the Kolmogorov-Smirnov test and the Independent sample t-test to test the two-sample equality of means. The researcher further utilized descriptive statistics to analyze data gathered from the questionnaires. The statistical analysis applied predominantly in the data analysis to investigate and explore differences between colleges of independent variables was One-way analysis of variance (ANOVA). One-way ANOVA is a statistical technique, which can be used to analyze multiple independent variables. One-way ANOVA tests whether means differ between independent variables under measure (Field, 2005, p.724). One-way ANOVA allows one to compare the effects of each independent variable individually (Ho, 2006, p.57), which is beneficial in the context of study.

Qualitative data was generated from focus group discussions with student teachers from all the three levels of year of study in both colleges of education. Focus Group Discussions (FGD) with student teachers were held in groups of 12 student participants according to the year of study. According to Onwuegbuzie (2009, p.3) it is recommended that, "well-designed focus groups usually last between 1 and 2 hours and consist of between 8 and 12 participants." Therefore, in this research, student teachers in each year of study, one group of 12 research participants were formed. According to Onwuegbuzie (2009, p.4) who cited Krueger (1994) and Morgan (1997) as having stated that, "...three to six different focus groups are adequate to reach data saturation and/or theoretical saturation with each grouping meeting once or multiple times." In this research, going according to the year of study, six focus groups were conducted with student teachers in the two Colleges of Education.

### 3. FINDINGS AND DISCUSSIONS

Findings from the quantitative data are presented first followed by the findings from qualitative data. The findings are presented according to the five research objectives.

#### 3.1: Student Teachers' Cognitive-Metacognitive Awareness

The first objective was to determine student teachers' cognitive-metacognitive awareness levels in their learning processes. Results from factor analysis indicated that the student teachers were on average metacognitive aware as the chi-square significance was 0.00 in both colleges. The initial eigenvalues percentage of variance was 55.080 for the first factor and 17.407 for the second factor. The first factor with eigenvalue percentage of variance of 55.080 was for the planning component and the eigenvalue percentage of 17.407 for the information management component. The remaining components had their eigenvalues less than 1 indicating their insignificance. Therefore, factor analysis indicated that student teachers' regulations of cognition levels were low.

**Table 1: MAI: Total Variance Explained- (all respondents' college B)**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.704	54.075	54.075	2.704	54.075	54.075	2.476	49.518	49.518
2	1.288	25.754	79.829	1.288	25.754	79.829	1.516	30.311	79.829
3	.564	11.280	91.110						
4	.434	8.670	99.780						
5	.011	.220	100.000						

Extraction Method: Principal Component Analysis.

Table 1 above shows the knowledge of cognition and regulation of cognition factors that were extracted for college B. It also indicates that the knowledge of cognition factor was higher than the regulation of cognition factor, indicating that student teachers have higher levels of knowledge of cognition than regulation of cognition. In brief, Factor 1 accounts for 46.977% of the variability in all eight variables, and factor 2 accounts for 25.510% of the variability in all the eight variables. In line with Belet and Guven (2011) assertions, students who have metacognitive skills, are aware of how to accomplish the problems posed in the learning processes. Belet and Guven (2011) research in USA was conducted and their results were actually closer to my research.

From Table 1 above, it indicates that the knowledge of cognition factor was higher than the regulation of cognition factor, indicating that student teachers have higher levels of knowledge of cognition than regulation of cognition. In literature **Self-regulation** refers to how a person regulates him/herself when solving a problem. This refers to self-generated thoughts, feelings and actions that are planned and cyclically adapted to the attainment of personal goals (Duckworth, et al., 2009, p.3). In brief, Factor 1 accounts for 49.518% of the variability in all five variables, and factor 2 accounts for 30.311% of the variability in all the five variables. In line with Zimmerman & Martinez-Pons (1986) research students with high metacognitive and self-regulatory abilities actively involved in their own learning process plan and monitor the task they are focusing on, their own study attitudes and the task and the study attitudes fits together.

The Principle Component Analysis method and the Varimax with Kaiser Normalization rotation method extracted two factors with Eigenvalues greater than one. The total initial eigenvalues percentage of variance value explained was 55.080 (college A) and 54.075 (college B) for the knowledge of cognition component with Eigen value 4.406 (college A) and 2.704 (college B). For the regulation of cognition component, college A had the initial eigenvalue of 17.407 while college B had 25.754 with Eigen values 1.393 and 1.288 respectively.

### 3.2 Metacognitive Awareness

Metacognitive awareness relates to individuals' awareness of where they are in the learning process or in the process of solving a problem, of their content-specific knowledge, and of their knowledge about their personal learning or problem solving strategies. (Wilson. J and Clarke. D, 2004). Rysz (2004, p.7) states that, "long before the word of 'metacognition' was coined sometime in the 1970's, people interested in how humans think, how the minds work, and how students learn wrote about the importance of cognitive thoughts."

The student teachers in the Focus Groups (FGs) discussions in both colleges under study all indicated that Mathematics was a necessary subject in schools and that it was very important in the development of the nation. Respondents in the focus group discussions indicated that when solving a problem, they take a break while thinking on to get to a next step. When they fail to find a solution, they consult each other even though they feel very sad for their failure. Most often, they go to the library to research for themselves as individuals so as the get deeper knowledge of new concepts in mathematics. Those participants who were not in agreement with the respondents who preferred to study individually, stated that they often refer problems to peers particularly in-group discussions. This clearly indicates that some student teachers do not regulate their cognitive processes as the participants even emphasized that during in-group discussions, they learn various procedures of solving problems without knowing the 'why' and 'when' to perform a correct process of solving a problem. Participants in the FGDs further indicated that when solving mathematical problems they often follow the procedures the lecturers employ even though they often do not understand the concepts taught clearly.

Further, respondents stated that most often they take a lot of the time with mathematics; they just follow the method solving the problem and do not understand why they should do so. After a while, they get some understanding of the reasoning. In the focus group discussions, participants were asked. To what extent, if any, do they learn to think about thinking in mathematics classes? Rather than specifically asking about cognitive-metacognitive strategies. The responses varied, but a common theme among majority of the participants was the attempt to implement such strategies on a daily basis, just as with learning to think mathematically. In the focus group discussions majority of student teachers indicated that when they encounter any problems when solving problems, they consult each other and even lecturers, though sometimes lectures do not show concern of their problems. Only a few of the participants stated that when they encounter problems in solving a mathematical problem, they do not consult their peers, as they do not feel good to ask others. This indicated that they do not ask or consult their peers for fear of being looked upon as low performing students. Other participants stated that they often take a break to think about of the problem at hand, and later they continue to find other alternative ways of solving the problem, indicating that they sometimes regulate their thinking processes and strategies to solve mathematical problems. In both colleges of education, FGDs participants echoed similar sentiments. Results therefore, show that some student teachers are metacognitive aware of their learning processes.

### 3.3 Perceptions and Attitudes

The second objective focused on perceptions and attitudes college student teachers have towards Mathematics in the focus group discussion the researcher asked respondents' how they perceive mathematics. Perception is a person's particular way of understanding or thinking about something and in this case Mathematics. This refers to the organisation, identification, and interpretation of a sensation in order to form a mental representation (Festus & Ekpete, 2012).

Participants in unison stated that mathematics is difficult due to teachers teaching methods. They stated in agreement that most teachers in secondary schools currently emphasis on procedural methods of solving problems. Four participants stated that teachers at the school they attended never allowed pupils to ask questions during lessons not even after class. Further, participants in the focus groups stated that most teachers concentrated on past paper revision.

The researcher asked participants the subject they liked most while at school. From the discussions, 116 of student teachers indicated that they liked mathematics with the 133 liking other subjects like Geometries and Mechanical Drawing (GMD), physics and principles of accounts indicating that a number of the student teachers perceive mathematics negatively. In response to why did you like the subject, those who liked the GMD subject stated that they liked the subject because their ambition was to be mechanical engineers upon completing school. Participants who liked mathematics stated that they liked mathematics most because it has less notes and

it is practical in nature. Other focus group participants stated that they liked the subject because the teachers who taught them the subject were making the subject interesting. Teachers motivated them in the way they taught, as they were friendly and often gave them guidance whenever they confronted problems in solving some problems. Contrary to the other participants, the some respondents stated that they liked mathematics because the subject is a multi-disciplinary field of study, which treats a wide range of diverse but interrelated areas. They said that they liked learning mathematics because the subject enables an individual to run his/her own business. The 25% of the focus group members agreed with them, with regard to the importance of the subject of mathematics. A number of respondents further stated that mathematics does not just empower learners with the capacity to control their lives but also provides a firm foundation for effective performance in other subjects like science subjects, engineering and computer technology.

One third year student teacher on the focus groups stated that mathematics is not difficult, but it depends on how the teacher teaches. He further stated that in some topics, lecturers do not interpret the topics in detail, and some lecturers even assume that students already know the concepts of a given topic and he referred to the question the researcher asked them about an even number. Participants further stated that there is need to improve the teaching processes at primary school level, as it is the foundation and critical level where learners develop strong perceptions of mathematics. According to one female participant, she stated that teachers at primary school do not teach to desired levels; as a result, they mislead pupils and often do not use mathematical language like “additive inverse of a number”. They further indicated that if primary school teachers are well qualified and have that passion to educate young ones, the performance of students and the education system in the country would improve. Student teachers further indicated that even though they like mathematics, it was involving and needed a lot of devotion to understand. One observation was that female student teachers had more positive perceptions about Mathematics than their male counterparts. This was observed during the FGDs as female student teachers felt that mathematics was easy to understand. One male student in the FGDs made a statement like, 'To tell the truth, mathematics is difficult to understand ...' Some even went to the extent of perceiving mathematicians as people who are not mentally normal.

Further, participants stated that mathematics promotes critical thinking and is helpful in solving real life problems. In the FGDs it is clear that student teachers have positive perceptions of mathematics, though with personal epistemologies that delves much in their personal gains. Students in the focus groups stressed the importance of understanding a concept before moving onto a new one. They viewed it as strategic to their progress and their success. Further, participants stated that they perceive mathematics as beneficial because it is a requirement for an individual to enter into college or university. When student teachers were questioned what changes in their college mathematics-learning experiences would have helped them be successful, the students stated that a change in attitude and in motivation by lecturers would make a difference. Respondents also referred to the influence of the examinations on what is taught and how it is taught in mathematics classrooms. Teaching and learning continue to be exam driven according to their observations in the colleges under study.

### **3.4 Student Teachers' perceptions on their academic performance and lecture methods of teaching.**

The third research objective was to establish student teachers' perceptions on their academic performance and lecturers' methods of teaching. The focus group discussions revealed that lecturers' moods and teaching approaches they utilize do not motivate student teachers in the learning processes. Participants in the focus groups agreed in unison that the lecturers in the colleges under study utilize three methods of teaching, which were; lecture method, cooperative method and project method, even though most often they use the lecture method. They stated that they had no problems in understanding some topics. The participants further stated that some lecturers always use one method that is lecture method of teaching continuously without involving the students in the learning process. Participants further indicated that lecturers often deny assisting student teachers when they find problems in solving mathematics problems instead; they refer them to the library to research on their own. Responses from participants regarding how they perceive their lecturers methods of teaching, they unanimously indicated that lecturers teach well in some topics even though in some topics they teach well. Further, respondents stated that lecturers' approaches are good in many topics except in a few topics like permutations and combinations, in which, they did not comprehend the concepts clearly.

The respondents further stated that some lecturers often teach them how to solve mathematical problems without explaining the contextualization of the concepts. In this context, respondents inferred that, lecturers' communicative language is not clear enough to enable student teachers to grasp new concepts. Participants in the focus groups indicated clearly that their mathematics teachers while at secondary school inspired him to become teachers too. They further stated that their teachers of mathematics were very smart and used to explain the mathematical concepts clearly and that led them to pass mathematics at grade twelve with distinctions or merits. The attitude of teachers enabled them to perform well in mathematics because they motivated them in class. Participants in the focus groups indicated that an individual's performance depends on his or her passion and diligence or volition to perform better. Participants even indicated that they were always

positive that they would pass the tests or examinations. Respondents indicated that they had positive perception of their performance in mathematics in both colleges of education.

### 3.5 Metacognitive Awareness levels between the two colleges

The fourth research objective was to determine whether student teachers' metacognitive awareness levels vary according to colleges. The Independent Samples t-test was conducted using the SPSS version 20.0. *Table 4.12a* below shows the group statistics where college A (1) had standard deviation of 20.05558 and college B (2) had standard deviation 16.74509. In *Table 4.12b* shows that student teachers' means do not vary according to colleges. From the independent samples t-test, the results indicate that  $t = 0.718, \rho > 0.05$ .

**Table 2: Independent Samples Test**

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
Means	Equal variances assumed	.086	.777	.718	8	.493	8.38800	11.68439	-18.55625	35.33225
	Equal variances not assumed			.718	7.753	.494	8.38800	11.68439	-18.70636	35.48236

Thus, from the results in *Table 4.12a* above, it was evident that there is no difference between the mean scores of college A and college B. The Levene's test showed that homogeneity of variance could be assumed with ( $t = 0.086 ; \rho = 0.777 \Rightarrow \rho > 0.05$ ). The Levene's test for Equality of Variances was greater than 0.05 indicating that there was no significant difference between the mean scores. We accept the null hypothesis that there is no difference between the mean scores in the two colleges. In line with the literature review student teachers in South Africa were also found to have high perceptions and metacognitive awareness towards mathematics but with low attitudes towards it Hugo and Blignaut (2008).

Further, a nonparametric test was performed to test the hypothesis, whether student teachers' means on their metacognitive awareness levels vary according to colleges. The hypothesis test summary of the Independent Samples Kolmogorov-Smirnov test indicated that the distributions of means are the same across categories of the colleges. The means of the two colleges was significant at 0.819. The test retained the null hypothesis. Savia A. Coutinho (2006) also examined the relationship between the need for cognition and metacognition and how these variables relate to intellectual task performance. There was a significant correlation between the need for cognition and metacognition (Coutinho , 2006) .

Further, to validate the results, the researcher further performed a One-Way Analysis of Variance (ANOVA) using the SPSS version 20.0. One-way ANOVA test was applied to observe whether there was a significant difference among the levels of metacognitive awareness of student teachers, according to colleges. *Table 4.13a<sub>1</sub>* indicates the results of one-way ANOVA test according means.

**Table 3: ANOVA**

			Sum of Squares	df	Mean Square	F	Sig.
Means college 1 * College 2	Between Groups	(Combined)	179.352	1	179.352	.622	.591
	Within Groups		2749.320	8	343.665		
	Total		2928.672	9			

The results of the One-Way analysis results indicated in *Table 4.13a<sub>1</sub>* indicated that the means in the two colleges did not vary significantly.

According to the results of the analysis, there was not a significant difference among the scores of metacognitive awareness of student teachers ( $F = 0.522; \rho = 0.491 > 0.05$ ) according to means. We accept the null hypothesis that the means in the two colleges of education do not vary since  $\rho > 0.05$  as indicated in the ANOVA according to (Ya-Hui, 2012). (To corroborate the findings produced from ANOVA test, the effect size measure eta-squared was performed. Measures of Association Eta Squared was  $0.061 < 1$ . Since the Eta Squared value ( $\eta^2$ ) was less than one, there was no significant difference in the variance of the means in the colleges. Therefore, the results show that the means did not vary in both colleges of education.

The fifth research objective was to determine whether student teachers' perceptions and attitudes towards mathematics vary according to college attended. Analysis using the SPSS version 20 was conducted to determine the variance of the means scores of student teachers' attitude towards mathematics. A nonparametric test was performed to test the hypothesis, whether student teachers' means on their attitudes towards

mathematics vary according to colleges. The hypothesis test summary of the Independent Samples Kolmogorov-Smirnov indicated that the distributions of means were the same across categories of the colleges. The means of the two colleges were significant at 1.000. Test retained the null hypothesis. The results therefore, indicate that the student teachers attitudes towards mathematic in the two colleges did not vary.

#### 4. DISCUSSIONS

The first objective was to investigate student teachers cognitive-metacognitive awareness levels. Firstly, the scores of MAI scale, which the researcher utilized in order to evaluate students metacognitive knowledge and skills, indicated that students had moderate levels of metacognitive awareness in both colleges of education. Factor analysis was conducted for the MAI data and in both colleges; factor analysis generated two factors, that is, metacognitive knowledge and regulation of cognition components. Analysis for college A data, the correlations of the subscales indicated in the correlation matrix that were above 0.410 to 0.740 ranges from moderate to moderate high indicated that the student teachers metacognitive awareness levels are moderately high. The subscales with the lowest correlation levels were monitoring, debugging, and evaluation in relation with procedural knowledge. These low correlations may imply that the student teachers from college A had less regulatory abilities of their cognitive processes in the learning of mathematics. These lower levels could be due to their lecturers' methods and approaches of teaching as suggested in the focus group discussions with the student teachers. Analysis for college B data, the correlation of the subscales indicated in the correlation matrix showed that all the subscales correlated above 0.5. This might be an indication that student teachers from college B were slightly more metacognitive aware than college A students.

The relationship between Knowledge of Cognition and Regulation of Cognition were statistically significant though moderately, in accord with previous research (e.g., Schraw and Dennison, 1994) in both colleges though college B had higher levels of regulation of cognition than college A. Schraw and Dennison (2004) state that students who are metacognitive aware and self-regulated also enjoy learning mathematics and perform better than students who are not aware of their metacognitive processes. Findings from the focus group discussions indicated that student teachers are not taught metacognitive skills and strategies. In accord with Hartman (2001) assertions in Rysz (2004, p.23) that, "Teaching with metacognition means that teachers will think about their own thinking regarding instructional goals, teaching strategies, sequence, materials, students' characteristics and needs, and other issues related to curriculum, instruction and assessment." This implies that lecturers or instructors in teacher training colleges need to think about their teaching approaches before teaching and plan well according to the classroom environment and culture of the learners. On the other hand, teaching for metacognition means that teachers will think about how their instruction will activate and develop their students' metacognition (Hartman, 2001b). From the findings of this study, it indicated that college lecturers do not teach with motivation as indicated in the focus group discussions with student teachers. In terms of lecturer characteristics, students indicated that they prefer a motivating, approachable devoted lecturer who respects students and makes time for each student. Desired teaching characteristics include multiple classroom activities and techniques coupled with clear explanations and many examples (Goodykoondz, 2008). These examples should be challenging, interesting, and useful in real life.

##### 4.1: Student Teachers' perceptions and attitudes towards mathematics

The second research objective was to establish the perceptions and attitudes college student teachers have towards Mathematics. Students' perception scores and their attitudes scores towards mathematics were found to be medium-positive. It may be that students believe that ability is a fixed entity because they are not aware of their own thinking processes. Perhaps if students do not believe that they can *learn to learn*, they may not try to become aware of their own cognition. From the focus group discussion findings, the student teachers indicated that their experiences of the learning processes from the secondary school influenced their perceptions and attitudes towards mathematics. Hare (1999), validated this thought, he stated that perceptions of mathematics are because of learners' past experiences both in the classroom and outside the learning situation. In focus group discussion, student teachers indicated that there was no motivation and social interaction among themselves. This is in accordance with Bandura's (1977) theory; motivation activates and is maintained by expectations concerning the predicted outcomes of actions, and self-efficacy for performing those actions. Social cognitive theorists assume that self-efficacy is a key variable affecting self-regulated learning (Bandura, 1986; Schunk, 1986; Zimmerman, 1986). Additionally, formation of academic attitudes has been identified as a complex process involving socialization, relationships with teachers, teacher attitudes and aspects of the subject matter itself (Taylor, 1992). When exploring the attitudes of pre-service (student teachers) teachers toward mathematics it is necessary not only to consider their attitudes towards the subject itself, but also their attitudes towards the teaching of mathematics. The attitudes of pre-service teachers are of particular importance because of their potential influence on pupils. Although the research evidence is certainly not conclusive, it has been sufficient to suggest that positive teacher attitudes contribute to the formation of positive pupil attitudes.

Findings from the focus group discussions indicated that student teachers do not have conative abilities. Conation is in the ‘work domain’. The ‘work domain’ is the connective tissue that puts knowledge (Cognitive) and feelings (affection) into action (Hannula, 2012). In focus group discussions student teachers indicated that they did not have the volition of good performance in their academic work. As stated by Riggs (2006, p.15) that, “In education, conation is the domain wherein action and will are engaged by the learner to produce academic persistence.”

#### **4.2 Student teachers’ perceptions on their academic performance, and lecturers’ methods of teaching.**

The third research objective focused on student teachers’ perceptions of their academic achievement and lecturers’ approaches of teaching. Findings indicated that student teachers perception of their performance is attributed to lecturers’ methods of teaching and lecturers’ attitudes towards them. Findings from the focus group with all the years of study indicated that lecturers teach them procedures of solving problem without their participation. They further indicated that lecturers taught the ‘how’ approach of solving mathematical problems without the ‘when’ and ‘why’ processes of solving problems. Such approaches of teaching could have resulted into student teachers having moderate levels of perceptions of their performance.

Therefore, from the preceding paragraph, student teachers’ academic performance could be affected by the teaching approaches lecturers utilize in their teaching processes in the learning of mathematics. Findings indicated that lecturers often utilize the lecture method of teaching where student teachers learn passively without actively getting involved in the learning process. That is as much as the role of the lecturers in the teaching-learning process cannot be underestimated; the study established that the respondents perceived their lecturers as the custodians of knowledge. This perception student teachers possess could be due to lecturers’ methods of teaching as indicated in the findings. Durojaiye (1976) supported the idea that teachers’ positive attitudes and good personal qualities bolster students’ academic performance. Abadejana (2000) also asserted that students prefer lecturers, who have competence in their subjects and who respect and trust the students. The lecturers’ methods of teaching are focused only to lecture method probably due to lack of conation (Reeves, 2006). A teacher’s behavior towards a student is a major determinant of the student’s perceived control. The relationship between the actions and outcomes, or the contingency of teachers, is important to how a student performs. Clear expectations and consistent feedback tend to enhance student achievement. A student’s perceptions about the involvement of teachers are also factors. Whether a student perceives the teacher to be helping or chastising affects the student’s academic performance (Shoenfeld, 1992). Steinbring,(1998, p.34) states that, “The teacher has to be able to diagnose and analyze students’ constructions of mathematical knowledge and has to compare those constructions to what was intended to be learned in order to vary the learning offers accordingly.”

### **5. CONCLUSION**

The findings indicated that students in the colleges of education have moderate positive perceptions, attitudes and metacognitive awareness levels. Therefore, generally results showed that student teachers in the colleges of education under study had above average positive perceptions and attitudes towards mathematics and metacognitive awareness levels. As a conclusion, this research established that student teachers have on average positive perceptions and attitude towards mathematics and moderately high levels of metacognition; it shows that there is still possible room for improvement. However, it is interesting to know that despite the lower performance of students in mathematics, the perceptions, attitude, and their metacognitive awareness levels of the respondents of this study were positive though not so high. The research also shows that the students’ perceptions and attitude towards mathematics and their metacognitive awareness levels do not have significant difference between college A and college B in accordance with research from Hannula (2012) in the literature review. In literature it shows that perceptions, attitudes and metacognition are intertwined according to Liljedahl (2012). Literature states that students with positive perceptions and attitudes develop metacognitive awareness. Hence, there is no big gap in perceptions, attitudes and cognitive-metacognitive awareness of student teachers in the two colleges under study in line with Hannula (2012) research in Sweden. Literature states that students with high perceptions and attitudes are metacognitively aware. It is highly recommended that the maximum effort should be given to improve the student teachers’ perceptions and attitude towards mathematics and their cognitive-metacognitive awareness levels and to conduct further studies to find factors influencing students’ perceptions and attitude towards mathematics and their metacognitive awareness levels. As mathematics teacher educators and researchers, we should not only support student teachers in their development of conceptual understanding, procedural fluency and understanding, and strategic competence; we must also provide opportunities for student teachers to become more aware of their affect and the role it plays in their mathematics learning. We can support student teachers in developing positive affect and mathematics dispositions by creating positive challenging mathematics learning and problem-solving experiences. Then, as a result, student teachers will gain experience in not only monitoring and controlling their cognition but also their affect toward

mathematics, mathematics learning, and problem-solving. This will perhaps enable student teachers to think about both the mathematics they teach and the mathematics learning and problem-solving experiences they create for their students. Although the study was limited to some few selected Colleges of Education in Zambia, however, the findings provide a meta-theoretical framework for further research into using student teachers' cognitive-metacognitive awareness and their perceptions and attitudes towards mathematics and of their lecturers' approaches of teaching in evaluating student teachers' teaching and the way forward. Therefore, there is need to bring or introduce teaching methods that will enhance students learning, like introducing the new revised Bloom's taxonomy in Zambia.

## REFERENCES

Bandura, A., (1986). Social foundations of thought and action: A social-cognitive theory. Upper Saddle River, NJ: Prentice-Hall.

Durojaiye, M.O.A., (1976). A new introduction to Educational Psychology. Ibadan; Evans Brothers Ltd.

Ernest, P., (1996). Question bank: Questionnaire on the teaching of Mathematics. [on-line] E-Mail: p.ernest@exeter.ac.uk.

Goodykoondz, E., (2008).Factors that Affect College Students' Attitudes towards mathematics. Retrieved 12<sup>th</sup> September 2012, from <http://sigmamaa.maa.org>.

Hare, A, Y, V, M., (1999). Revealing what Urban Early Childhood Teachers think about Mathematics and how they teach it: Implications for Practice. Retrieved 7<sup>th</sup> January 2013 from: <http://people.exeter.ac.uk>.

Hartman, H. J., (2001). Metacognition in Learning and Instruction: Theory, Research, and Practice. Chapter 8 Dordrecht, The Netherlands: Kluwer Academic Publishers.149 -169. Retrieved 9<sup>th</sup> July, 2012, from <http://condor.admin.ccny.cuny.edu/~hhartman/tchmtlyjhj.html>.

Hugo and Blignaut (2008), Journal of Education, [www.ukzn.ac.za/joe](http://www.ukzn.ac.za/joe)

Jirotkova, D and Stelikova, N (2004). Constructivist Approaches in the Education of Future Teachers, A case of Geometry, Retrieved 1<sup>st</sup> Aprils, 2011 from, <http://peoplelearn.homestead.com>.

McLeod, D.B., (1992). Research on Affect in Mathematics: A Reconceptualization. In D. A Grouws (Ed.), Handbook of Research on Mathematics teaching and learning, MacMillan: New York.

Ministry of Education (MoE). (1996). Educating our Future: National Policy on Education. Zambia Educational Publishing House: Lusaka.

Mulendema, P., (2007). Perceptions and Attitudes of Zambian High School Pupils towards Mathematics: A case of Selected Schools on the Copperbelt, Masters Dissertation, University of Zambia: Lusaka.

Reeves, C. T., (2006). How do you know they are learning?: The importance of alignment in higher education. Retrieved 5<sup>th</sup> March, 2012 from, <http://net.educause.edu/ir/library>.

Riggs, G. R., (2006). Conation: Cultivating the Will to Succeed Among Middle and High School Students. Retrieved 11<sup>th</sup> November, 2012, from <http://www.teachstream.com>.

Rysz, T., (2004). Metacognition in Learning Elementary Probability and Statistics. Retrieved 9<sup>th</sup> September, 2012 from, <http://www.peoplelearn.homestead.com>.

Schraw, G., and Dennison, R. S., (1994). Assessing Metacognitive Awareness, Retrieved 28<sup>th</sup> June, 2012 from, <http://sitesgoogle.com>.

Shoenfeld, A.H., (1992). Learning to Think Mathematically: Problem Solving, Metacognition, and Sense making in Mathematics. In D.G., Grouws (Ed.), Handbook for Research in Mathematics Teaching and Learning, MacMillan: New York.

Sidhu, K . S., (2012). Methodology of Research in Education. Sterling Publishers Pvt. Ltd, New Delhi-110020.

Steinbring, H.,(1998), 'Elements of epistemological knowledge for mathematics teachers',Journal for Mathematics Teacher Education 1, 157–189.

Taylor, L. (1992). Mathematical attitude development from a Vygotskian perspective.Mathematics Education Research Journal, 4, 8-23.

Savia A. Coutinho (2006) The Relationship between the Need for Cognition, Metacognition, and Intellectual Task Performance, <http:// www.academicjournals.org/ERR>